

1 REMARKS

2 Status of the Claims

3 Claims 1-46 remain pending in the present application, Claims 45 and 46 having been added  
4 and Claims 1 and 20 having been amended to more clearly define the subject matter.

5 Summary of Telephone Interview With Examiner

6 On Thursday May 8, 2008, applicants' attorney (Sabrina MacIntyre, Registration No. 56,912)  
7 conducted a brief telephone interview to discuss the current Final Office Action with Examiner Senfi in  
8 view of the Sullivan references and the proposed amendments that had been faxed at an earlier date.

9 Applicants' attorney briefly summarized the nature of the amendments and how the language of  
10 Claim 1 distinguishes over the cited art. More specifically, with respect to the proposed amendment for  
11 independent Claim 1 step (a), applicants' attorney explained that they were trying to clarify the definition of  
12 a large depth of focus display, by reciting that in such a display, "all elements in the image are initially  
13 displayed at an optical focus level that is substantially the same for all elements." Applicants' attorney also  
14 briefly summarized how the Sullivan references, in contrast, teach a narrow depth of focus display (as  
15 discussed in greater detail below). Examiner Senfi indicated that this definition of a large depth of focus  
16 display still appeared to be too broad and noted that it would be helpful to make additional clarifying  
17 amendments to explain what is meant by this term, so that it might be clear how the claims distinguish over  
18 the cited art.

19 Applicants' attorney and Examiner Senfi discussed adding additional language to the claim, for  
20 example, to indicate that such a display presents an unnatural viewing condition to a user. Although no  
21 agreement regarding the patentability of the claims was reached during the telephone interview, the  
22 Examiner indicated that a clearer definition of this term would be very helpful in advancing prosecution of  
23 this case and invited applicants' attorney to call him when the Response is submitted.

24 Applicants' attorney would like to again thank Examiner Senfi for his time and willingness to  
25 discuss these issues during the Telephone Interview.

26 Allowable Subject Matter

27 Claims 42 and 43 are objected to as being dependent upon a rejected base claim, but would be  
28 allowable if rewritten in independent form including all of the limitations of the base claim and any  
29 intervening claims. Accordingly, new Claim 45 has been added that incorporates the recited subject  
30 matter of Claims 7, 8, 12, and 42 into independent Claim 1.

1 Similarly, new Claim 46 has been added that incorporates the recited subject matter of  
2 Claims 7, 8, 12, and 43 into independent Claim 1. Both of these new claims should thus be  
3 patentable.

4 Claims Rejected Under 35 U.S.C. § 103(a)

5 Claims 1, 2, 5-10, 15, 17, 19-21, 24-29, 34, 36, 38, and 41 have been rejected under  
6 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent Publication No. 2002/0163482 (Sullivan,  
7 hereinafter referred to as "Sullivan1"), in view of U.S. Patent Publication No. 2003/0086062  
8 (Shevlin), and further in view of U.S. Patent Publication No. 2003/0067421 (Sullivan, hereinafter  
9 referred to as "Sullivan2").

10 Claims 3, 16, 18, 22, 35, 37 and 39-40 have been rejected under 35 U.S.C. § 103(a) as being  
11 unpatentable over Sullivan1, in view of Shevlin, in view of Sullivan2, and further in view of U.S.  
12 Patent No. 6,449,309 (Tabata).

13 Claims 4, 11, 13, 14, 23, 30 and 32-33 have been rejected under 35 U.S.C. § 103(a) as being  
14 unpatentable over Sullivan1, in view of Shevlin, in view of Sullivan2, and further in view of U.S.  
15 Patent No. 6,133,944 (Braun et al., hereinafter referred to as "Braun").

16 Claims 12, 31, and 44 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over  
17 Sullivan1 in view of Shevlin, in view of Sullivan2, and further in view of U.S. Patent No. 5,954,414  
18 (Tsao).

19 Applicants respectfully disagree with the above rejections for at least the following reasons.

20 In the interest of reducing the complexity of the issues for the Examiner to consider in this  
21 response, the following discussion focuses on independent Claims 1 and 20. The patentability of  
22 each remaining dependent claim is not necessarily separately addressed in detail. However,  
23 applicants' decision not to discuss the differences between the cited art and each dependent claim  
24 should not be considered as an admission that applicants concur with the Examiners conclusion that  
25 these dependent claims are not patentable over the disclosure in the cited references. Similarly,  
26 applicants' decision not to discuss differences between the prior art and every claim element, or every  
27 comment made by the Examiner, should not be considered as an admission that applicants concur  
28 with the Examiner's interpretation and assertions regarding those claims. Indeed, applicants believe  
29 that all of the dependent claims patentably distinguish over the references cited. In any event, a  
30 specific traverse of the rejection of each dependent claim is not required, since dependent claims are

1 patentable for at least the same reasons as the independent claims from which the dependent claims  
2 ultimately depend.

### 3 Patentability of Independent Claim 1

4 Significant differences exist between the recited subject matter and the cited art because the  
5 cited art does not teach or suggest a large depth of focus display that simulates an unnatural viewing  
6 condition, but instead teaches a narrow depth of focus display. Step (a) recites (emphasis added):

7 displaying an image to a viewer on a large depth of focus display wherein all elements  
8 in the image are initially displayed at an optical focus level that is substantially the  
9 same for all elements, thereby simulating an unnatural viewing condition, since  
10 elements viewed at different depths should naturally appear at different focus levels

11 Applicants have amended step (a) to clarify that the viewer is viewing the image on a *large*  
12 *depth of focus display*, which simulates an unnatural viewing condition with all elements at  
13 substantially the same optical focus level. Before explaining where support is provided in the  
14 specification for these amendments, it may be helpful to provide some background information in  
15 order to help distinguish applicants' *large* depth of focus display from the cited art's *narrow* depth of  
16 focus display. The specification explains that the human eye has a limited Depth of Focus (DOF) and  
17 that when viewing a real scene in which objects are at different depths, not every object in the scene  
18 will be observed in focus at the same time. Accordingly, the focus of the observer's eyes adjusts to  
19 bring objects into focus (specification, page 2, lines 4-7) when the observer's gaze is directed at  
20 objects at different depths in the real scene. More specifically, our eyes monitor blur feedback and  
21 make corrections, and this process of *natural* viewing and focusing is known as closed-loop  
22 accommodation (specification, page 3, lines 1-4) because the blur feedback loop is intact or "closed."  
23 In contrast, we can artificially increase the DOF of our eyes, for example, by viewing a scene through  
24 a small pinhole, and by doing so, **both distant and near objects are observed in focus at the same**  
25 **time** (specification, page 3, lines 7-9). By viewing the scene through a pinhole, blur feedback is  
26 decreased or substantially removed, which produces an open-loop accommodation (specification,  
27 page 3, lines 7-11). FIGURE 1 illustrates a virtual retinal display (VRD), which is an example of a  
28 large DOF display (specification, page 9, lines 15-16). All the rays projected from the VRD  
29 converge at a small exit pupil, so the images it projects on the observer's retina have a large DOF  
30 (specification, page 9, lines 23-25). Since the display creates the equivalent of a "pinhole" aperture at  
its exit pupil, it projects a clear image on the back of a viewer's retina that is independent of the

1 degree of a viewer's accommodation (specification, page 9, lines 26-28), and in which all objects at  
2 different depths in a scene appear to be in focus at the same time. It is important to note that since the  
3 image viewed by the eye is provided with a large DOF, the light rays that form the image are in focus  
4 on the retina in both views 20 and 40 (specification, page 9, line 31-page 10, lines 2). Because all  
5 planes in which objects in a scene are observed with such a display remain in focus throughout the  
6 range of accommodation of the viewer's eye, the viewer is provided with little or no feedback to the  
7 accommodative system, giving rise to open-loop accommodation (specification, page 10, lines 2-4).  
8 And, as described above, open-loop accommodation lacks the blur feedback, which is the condition  
9 described in step (a) of Claim 1 in regard to the display of an image on a large depth of focus display.  
10 All elements in the image are thus initially displayed at substantially the same optical focus level  
11 regardless of their depth in the image, because the image has been displayed on a large depth of focus  
12 display. Thereby, the user is caused to have an open-loop accommodation that is unnatural or  
13 artificial, as compared to a closed-loop accommodation, which is a natural viewing condition when a  
14 real scene is observed by the eye.

15 In contrast, Sullivan2 does NOT teach a large depth of focus display, but instead teaches a  
16 narrow depth of focus display. The Examiner asserts that although Sullivan1 does not explicitly  
17 mention a large depth of focus display (page 4 of Office Action dated January 28, 2008), Sullivan2  
18 teaches a large depth of focus display and cites to page 2, paragraphs 0014-0017 of Sullivan2 in  
19 support of this assertion. Applicants respectfully disagree and summarize below why Sullivan2  
20 actually teaches a narrow depth of focus display. Paragraphs 0014 - 0016 from Sullivan2 are  
21 reproduced below to aid in this discussion.

22 [0014] In the prior art multi-planar volumetric display system of FIG. 1, the optics 22  
23 of the projection lens is set to a fixed focus such that the inherent depth of focus is  
24 capable of producing an adequately resolved image over some range of image  
25 distances. As known in the art, the depth of focus is a function of the f-number of the  
26 optical projection system. For a simple lens, the f-number is the focal length of the  
27 lens divided by the effective diameter of the lens (or linear aperture). Thus, the depth  
28 of focus increases with increasing f-number. *As a consequence, a multi-planar*  
29 *volumetric display system as shown in FIG. 1 requires an optical projection system*  
30 *having a relatively high f-number in order to provide a sufficiently large depth of*  
**focus to span the entire extent of the MOE device 32 along the optical axis. However,**  
**the amount of light that an optical system can collect from available high**  
**brightness light sources decreases with increasing f-number and this**  
**consequently limits the brightness of the image that can be obtained from a**

1 **multi-planar volumetric display** system having the exemplary arrangement shown in  
2 FIG. 1. (Emphasis added.)

3 [0015] Hence, in prior art multi-planar volumetric display systems, there is an inherent  
4 design tradeoff that is accommodated between the need for a sufficient depth of focus  
5 to cover the entire MOE device 32 within the resolution requirements designed for the  
6 display and the desire to project high amounts of light for high image brightness.

7 [0016] For the foregoing reasons, there is a need for a rapidly adjustable variable  
8 focusing projection system that can provide a focused image over a range of image  
9 distances which span the extent of the multiple optical element device, thereby making  
10 it possible to employ relatively low f-number optics and high brightness light sources  
11 to produce bright images.

12 Sullivan2 is describing prior art that is directed toward a large depth of focus projector.  
13 However, it is important to understand that a large depth of focus projector is VERY different from a  
14 large depth of focus display. Sullivan2 describes projecting an image on a series of physical planes  
15 that are at different depths, or onto a plurality of LCDs (for example optical elements 36-42 of  
16 Figure 1) at different depths in its multi-planar volumetric display system 10. This system uses one  
17 projector 20 to project images sequentially onto the screens or LCD panels at different depths.  
18 Sullivan needs a projector that can simultaneously project the different components of the image onto  
19 different screens in focus, without having to change anything in the physical configuration of the  
20 display system, as highlighted in the italic portion above. But, as highlighted in the bold font portion  
21 above, using a small aperture to project the component of the images onto the different screens,  
22 would dramatically limit the amount of light available to create the images. This solution is the  
23 design trade-off that is indicated in paragraph 0015. So instead, the solution used by Sullivan2 is to  
24 employ a variable focus projector that can physically be modified to sequentially focus on each plane  
25 (as described in paragraph 0016).

26 However, the Sullivan2 system produces a narrow depth of focus display, although it uses a  
27 large depth of focus projector to project images onto the screens at different depth planes. Each plane  
28 in Sullivan's system is a scattering medium, so that the light projected onto each plane scatters in all  
29 directions and as a result, the planes at different depths in the Sullivan system are at different focus  
30 levels – not at the same focus level. Sullivan2 thus describes a system in which the observer is  
provided a narrow depth of focus view, since the viewer's eyes will have to focus differently at the  
different plane depths to see the image components on the different planes in focus. This system of

1 Sullivan2 thus creates a narrow depth of focus view for the observer, since the light from each plane  
2 fills or overfills the entrance pupil of the eye. In contrast, if all light passing through a region of  
3 space relative to a scene enters the observer's eye in a beam that is smaller than the pupil, as is the  
4 case when observing a scene through a pinhole, then the display is a large depth of focus display in  
5 which all elements are in focus at the same time, even though at different focus depths.

6 A large depth of focus display is what is generated *initially* in step (a), in other words, before  
7 blur feedback is applied, thereby simulating an unnatural or artificial viewing condition. When the  
8 image elements are presented to the viewer on the large depth of focus display, they all appear to  
9 reside at the same physical viewing distance, which is very different from Sullivan2, wherein the  
10 different planes of screens include image elements at different multiple physical viewing distances.  
11 Then in step (b), an accommodation is determined. Applicants have clarified that this happens when  
12 a gaze of the viewer is directed toward an element in the image (specification, page 14, lines 21-22).  
13 Then blurring is added, as recited in step (c). The specification, explains for example, if the viewer's  
14 eye accommodates to a distance of five meters, the computing device leaves objects near the five  
15 meter point in the scene unblurred, but blurs other objects that are at different depths in the scene, in  
16 proportion to their distance from the five meter focus point. The computing device outputs the  
17 selectively blurred image to the large DOF display (specification, page 14, line 28-page 15, line 2).  
18 What is now presented to a user is a simulation of a natural or artificial viewing condition in which  
19 all objects are NOT simultaneously in focus. Accordingly, the rejection of independent Claim 1  
20 under 35 U.S.C. § 103(a) should be withdrawn because the cited art does not teach or suggest all of  
21 the recitation of Claim 1.

22 Since dependent claims inherently include all of the recitation of the independent claims from  
23 which they ultimately depend, for at least the same reasons as noted above in connection with  
24 independent Claim 1, the rejection of dependent Claims 2-19, and 42 -44 should also be withdrawn.

#### 25 Patentability of Independent Claim 20

26 Independent Claim 20 is directed toward a system for more accurately conveying depth in an  
27 image. The Examiner has rejected Claim 20 for reasons similar to those given for the rejection of  
28 Claim 1. Applicants have amended this claim in a manner similar to that by which they amended  
29 Claim 1.  
30

1 Thus, applicants respectfully submit that for the reasons given above in their traversal of the  
2 rejection of Claim 1, significant differences exist between the recited subject matter and the cited art,  
3 because the cited art does not teach or suggest a large depth of focus display. Accordingly, the  
4 rejection of independent Claim 20 under 35 U.S.C. § 103(a) should be withdrawn because the cited  
5 art does not teach or suggest all of the recitation of Claim 20.

6 Since dependent claims inherently include all of the recitation of the independent claims from  
7 which they ultimately depend, for at least the same reasons as noted above in connection with  
8 independent Claim 20, the rejection of dependent Claims 21-41 should also be withdrawn.

9 Conclusion

10 In consideration of the amendment to the claims and the Remarks set forth above, it is  
11 applicants' position that all claims in the current application are patentable over the art of record.  
12 The Examiner is thus requested to pass this case to issue without further delay. In the event that any  
13 other issues remain, the Examiner is invited to telephone applicants' attorney at the number listed  
14 below.

15  
16 Respectfully submitted,

17  
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